Chapter 1
Introduction

1-1. Purpose

This manual provides technical specifications and procedural guidance for surveying with the NAVSTAR Global Positioning System (GPS). It is intended for use by engineering, topographic, or construction surveyors performing surveys for civil works and military construction projects. Procedural and quality control standards are defined to establish Corps-wide uniformity in GPS survey performance and GPS architect-engineer (A-E) contracts.

1-2. Applicability

This manual applies to HQUSACE elements, major subordinate commands, districts, laboratories, and field operating activities having responsibility for the planning, engineering and design, operations, maintenance, construction, and related real estate and regulatory functions of civil works and military construction projects. It applies to GPS survey performance by both hired-labor forces and contracted survey forces. It is also applicable to surveys performed or procured by local interest groups under various cooperative or cost-sharing agreements.

1-3. References

Required and related publications are listed in Appendix A.

1-4. Explanation of Abbreviations and Terms

GPS surveying terms and abbreviations used in this manual are explained in the Glossary (Appendix B).

1-5. Trade Name Exclusions

The citation or illustration in this manual of trade names of commercially available GPS products, including other auxiliary surveying equipment, instrumentation, and adjustment software, does not constitute official endorsement or approval of the use of such products.

1-6. Accompanying Guide Specification

A guide specification for the preparation of A-E contracts for GPS survey services is contained in Appendix G.

1-7. Background

GPS surveying is a process by which highly accurate, three-dimensional (3D) point positions are determined from signals received from NAVSTAR satellites. GPS-derived positions may be used to provide the primary reference control monument locations for engineering and construction projects, from which detailed site plan topographic mapping, boundary demarcation, and construction alignment work may be performed using conventional surveying instruments and procedures. GPS surveying also has application in the continuous positioning of marine floating plants. GPS surveying can also be used for input to Geographic Information System (GIS) and mapping projects.

1-8. Scope of Manual

This manual deals primarily with the use of differential carrier phase GPS survey techniques for establishing and/or extending project construction or boundary control. Both static and kinematic survey methods are covered, along with related GPS data reduction, post-processing, and adjustment methods. Differential code phase GPS positioning and navigation methods supporting hydrographic surveying and dredge control are covered to a lesser extent (see EM 1110-2-1003 for further information on hydrographic surveying with GPS). Kinematic (or dynamic) real-time differential carrier phase GPS surveying applications are covered in detail in this manual. Absolute GPS point positioning methods (i.e., nondifferential) are also described since these techniques have an application in some USACE surveying and mapping projects.

a. This manual is intended to be a comprehensive reference guide for differential carrier phase GPS surveying, whether performed by in-house, hired-labor forces, contracted forces, or combinations thereof. General planning criteria, field and office execution procedures, and required accuracy specifications for performing differential GPS surveys in support of USACE engineering, construction, operations, planning, and real estate activities are provided. Accuracy specifications, procedural criteria, and quality control requirements contained in this manual shall be directly referenced in the scopes of work for A-E survey services or other third-party survey services. This is intended to ensure that uniform and standardized procedures are followed by both hired-labor and contract service sources throughout USACE.

b. The primary emphasis of the manual centers on performing second- and third-order accuracy surveys. This accuracy level will provide adequate reference control from which supplemental real estate, engineering, construction layout surveying, and site plan topographic mapping work may be performed using conventional survey techniques. Therefore, the survey criteria given in this manual will not necessarily meet the Federal Geodetic Control Subcommittee (FGCS) standards and specifications required for the National Geodetic Reference System (NGRS). However, it should be understood that following the methods and procedures given in this manual will give final results generally equal to or exceeding FGCS second-order relative accuracy criteria. This is adequate for the majority of USACE projects.

c. Chapter 12 herein on GPS cost estimating is intended to assist those USACE Commands which primarily contract out survey services. Refer to Appendix G for further information concerning the contracting of GPS services.

d. This manual briefly covers the theory and physical concepts of NAVSTAR GPS positioning. Consult the related publications in Appendix A for further information.

1-9. Life Cycle Project Management Applicability

Project control established by GPS survey methods may be used through the entire life cycle of a project, spanning decades in many cases. During initial reconnaissance surveys of a project, control established by GPS should be permanently monumented and situated in areas that are conducive to the performance or densification of subsequent surveys for contract plans and specifications, construction, and maintenance. During the early planning phases of a project, a comprehensive survey control plan should be developed which considers survey requirements over a project's life cycle, with a goal of eliminating duplicative or redundant surveys to the maximum extent possible.

1-10. Metrics

Metric units are used in this manual. Metric units are commonly used in geodetic surveying applications, including the GPS survey work covered herein. GPS-derived geographical or metric Cartesian coordinates are generally transformed to non-SI units of measurements for use in local project reference and design systems, such as State Plane Coordinate System (SPCS) grids. In all cases, the use of metrics shall follow local engineering and construction practices. Non-SI/metric equivalencies are noted where applicable, including the critical--and often statutory--distinction between the U.S. Survey Foot (1,200/3,937 m exactly) and International Foot (30.48/100 m exactly) conversions.

1-11. Manual Development and Proponency

The HQUSACE proponent for this manual is the Surveying and Analysis Section, General Engineering Branch, Civil Works Directorate. The manual was developed by the U.S. Army Topographic Engineering Center (USATEC) during the period 1992-1994 under the Civil Works Guidance Update Program, U.S. Army Engineer Waterways Experiment Station. Primary technical authorship and/or review was provided by the U.S. Army Engineer Districts, Pittsburgh, Tulsa, Detroit, New Orleans, and St. Louis. Recommended corrections or modifications to this manual should be directed to HQUSACE, ATTN: CECW-EP-S, 20 Massachusetts Ave. NW, Washington, DC 20324-1000.

1-12. Distribution

Copies of this document or any other Civil Works Criteria Documents can be obtained from: U.S. Army Corps of Engineers, Publications Depot, 2803 52nd Ave, Hyattsville, MD 20781-1102, Phone: (301) 394-0081.

1-13. Further Information

Further information on the technical contents of this manual can be obtained from:

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